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of Transportation

**Federal Aviation
Administration**

CONFIGURATION MANAGEMENT MANUAL

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Foreword

This FAA Configuration Management Manual is being distributed to provide guidance to FAA personnel with Configuration Management (CM) in all three phases of a project's life-cycle - Requirements Determination, Acquisition, and Operational Support. It is intended the manual be used in conjunction with FAA Orders and other guidance on the subject which are highlighted in Appendix B. This document is especially useful to use in conjunction with the recently released Configuration Management Procurement Guidance.

Should you have any comments or requests, you can use the enclosed form letter to transmit them.

FEDERAL AVIATION ADMINISTRATION
CONFIGURATION MANAGEMENT MANUAL

CONFIGURATION MANAGEMENT MANUAL

1.0 GENERAL

1.1 PURPOSE

The purpose of this manual is to provide an overall understanding of the configuration management discipline and to provide a framework in which managers can apply Configuration Management (CM) to their project area.

1.2 INTRODUCTION

Configuration Management is a management and technical discipline that provides a means of controlling and documenting a development and production process. The main objectives of CM are to guarantee that the product the user/purchaser receives performs both functionally and physically as intended, and that the product is maintainable. Also, as an essential management tool, CM is used to provide project visibility and traceability, document performance requirements and achievements, minimize project costs, ensure schedules are met, and ensure system integrity. Figure 1 depicts an overview of configuration management.

The benefits of CM are provided by overseeing the design, development, production and modification process. CM provides formal control of the technical requirements and ensures adequacy of documentation throughout a subsystem life-cycle. Proper execution of CM guidelines provides the basis for a smooth transition of CM requirements from one organization to another. In addition, CM provides the mechanism for identification of the configuration to the line replaceable unit assuring repeatable performance, quality and future reliability and maintainability.

1.3 BACKGROUND

Configuration management is based on good business and engineering practices. During the early growth phase of large, integrated, high technology systems, companies did not practice regulated

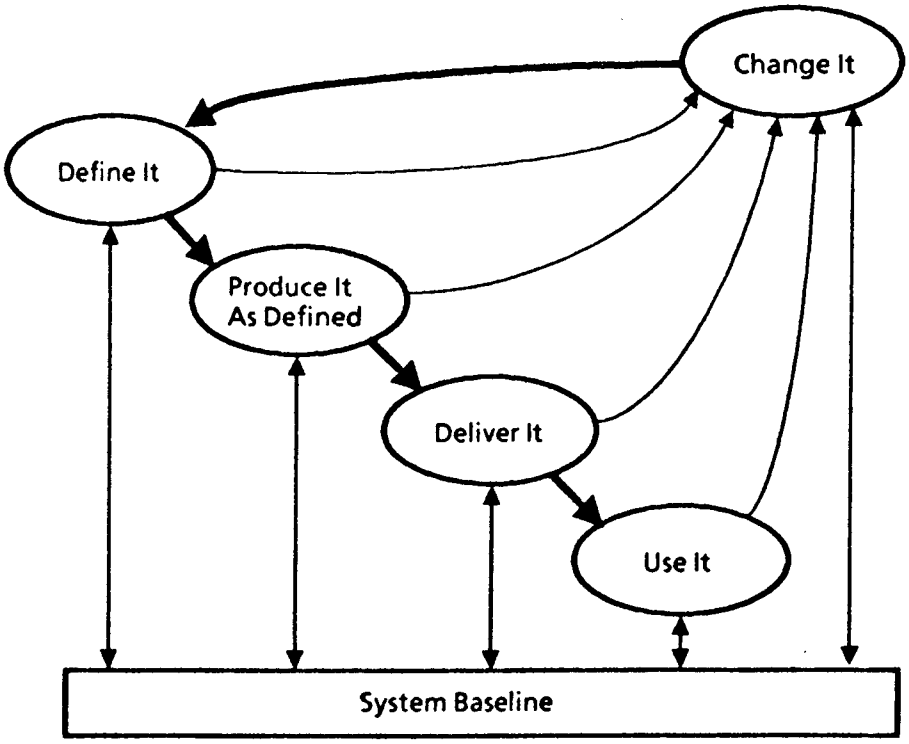


Figure 1 - Configuration Management

self-control in the development of products and associated documentation. This became apparent during a missile launch in the 1950's when a company could not duplicate a successful missile. The company did not have adequate records of part number identification, change history or change implementation status, and the accompanying documentation did not reflect the many changes that had been made.

Furthermore, the government found that large systems were being delivered with inadequate information relating to the build or maintenance process. If documentation was delivered, it was usually inaccurate and incomplete. Components would be tested and approved and later found to be altered, usually after they failed in service. Only the original manufacturer could supply the necessary system or component because no one could tell anyone else how it was developed. Overall, multiple versions of configuration items (CI's) were often undiscovered until maintenance,

troubleshooting, spares interchangeability, and supporting documentation presented compatibility problems. The government had no method in place to ensure that it was receiving quality products.

The "formal set of procedures" establishing configuration management requirements have grown out of military specifications and contract documentation. Uniform procedures started with an initial guideline for "engineering change proposals" and progressed to technical, fiscal, interface, and logistic support information.

The government now recognizes configuration management as an important element of its management system. The National Air and Space Administration (NASA) and the Department of Defense (DOD) have been strong advocates of configuration management and have been instrumental in developing policy and guidelines on all elements of a CM program.

The Federal Aviation Administration's (FAA) CM effort was initiated over twenty years ago with the procurement of the IBM 9020. With the advent of the National Airspace System (NAS) Plan, the FAA is still relying on configuration management. As the FAA program evolves, configuration management practices are tailored and refined to accommodate and verify each NAS Plan subsystem. Overall, the FAA has utilized a systems engineering approach to the NAS modernization program. CM has served as a critical tool to ensure efficient NAS development. The FAA has several CM publications applied at different times throughout a subsystem's life-cycle ensuring that documentation on each CI is identified and appropriately maintained. See Appendix A, Reference Documents, for a complete listing and Appendix B, Selected Document Descriptions, for a brief explanation of specific documents.

The FAA's CM program has several objectives:

- Identify cost associated with changes

- o Control review time involved in change decisions
- o Ensure efficient implementation of approved changes
- o Ensure that product and product documentation match
- o Ensure that total cost of changes is known at time of approval
- o Control deviations and waivers
- o Ensure no items of unknown configuration are in use
- o Ensure technical documentation is sufficient for its intended purpose
- o Ensure a single authority is responsible for change control
- o Ensure that procurement documentation is sufficient in addressing government requirements
- o Ensure that change proposals are utilized for recognized cost savings.

2.0 NAS LIFE-CYCLE

The term life-cycle refers to the orderly progression a subsystem follows from its conception through to its decommission. The term can be applied to many aspects of the NAS; a subsystem, a particular product, or the entire NAS itself. In every case, engineering changes are an essential part of planning, development, and maintenance of a complex product, since without change, there can not be evolutionary improvement. CM accommodates these changes during the life-cycle as normal business - something to be managed, making change an essential element of technical growth and cost effectiveness.

For our purposes we will concentrate on the subsystem life-cycle. During this process the CM discipline is applied at every step. Note that a NAS subsystem life-cycle is more complex than traditional processes due to the fact that there is a current operational NAS system in place. This existing NAS system is gradually being transformed into the next generation system. Therefore, portions of the system life-cycle phases are always in execution. The life-cycle of each individual subsystem is embedded in the overall NAS system life-cycle.

There are three basic life-cycle phases: requirements determination, acquisition, and operational support. See Figure 2 for a representation of the NAS life-cycle model. The requirements determination phase focuses on the definition of functional operational requirements and the establishment of NAS designs. These efforts specify quantities of equipment, software requirements and top-level interface definitions. Figure 3 portrays the hierarchy for NAS documentation. It depicts the relationships among the top level NAS requirements and design documents, and hardware and software acquisition documentation. In the acquisition phase, functional requirements are allocated to components; component interface requirements are determined and documented; and equipment, software, and firmware are designed, developed, produced, installed, and commissioned. In the operational support phase, services are provided that maintain subsystems in the most efficient and cost-effective manner. Additional information on life-cycle activity is presented in the remaining portions of this document.

3.0 FAA GENERAL CONFIGURATION MANAGEMENT STRUCTURE

The FAA CM program provides a structure throughout the life-cycle to ensure project/product traceability and product configuration integrity. The major elements are described in this section.

3.1 BASIC ACTIVITIES. The FAA CM program can be viewed as four basic activities. These activities are of equal importance to the program - no attempt is made to emphasize one topic over another. In fact, CM is a series of interoperable processes that provide a mechanism toward assuring product integrity.

o Configuration identification is the currently approved or conditionally approved technical documentation of a CI as set forth in specifications, drawings and associated lists, etc., and documents referenced therein.

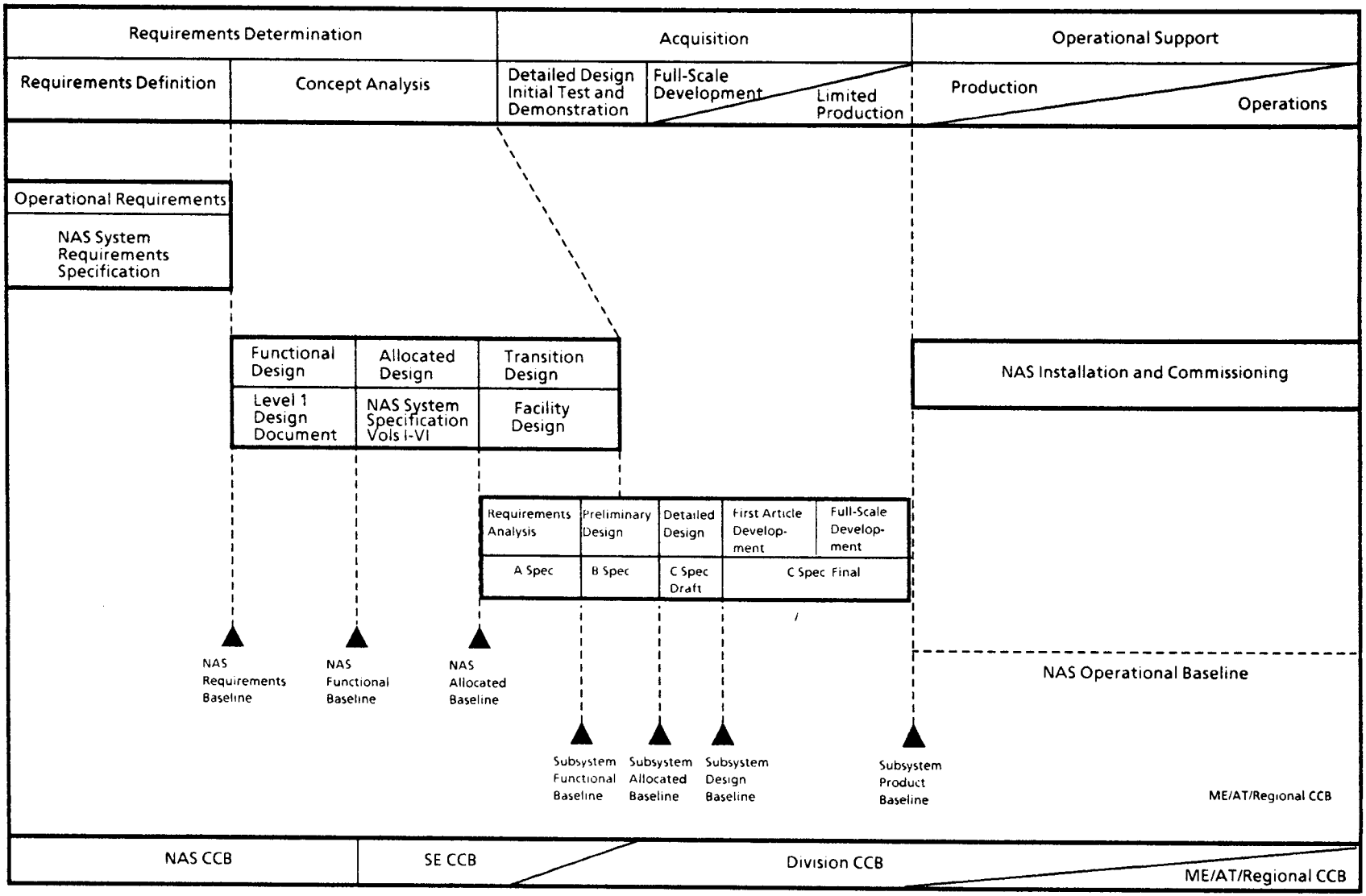


Figure 2 - NAS Life-Cycle Model

NAS Level Documentation

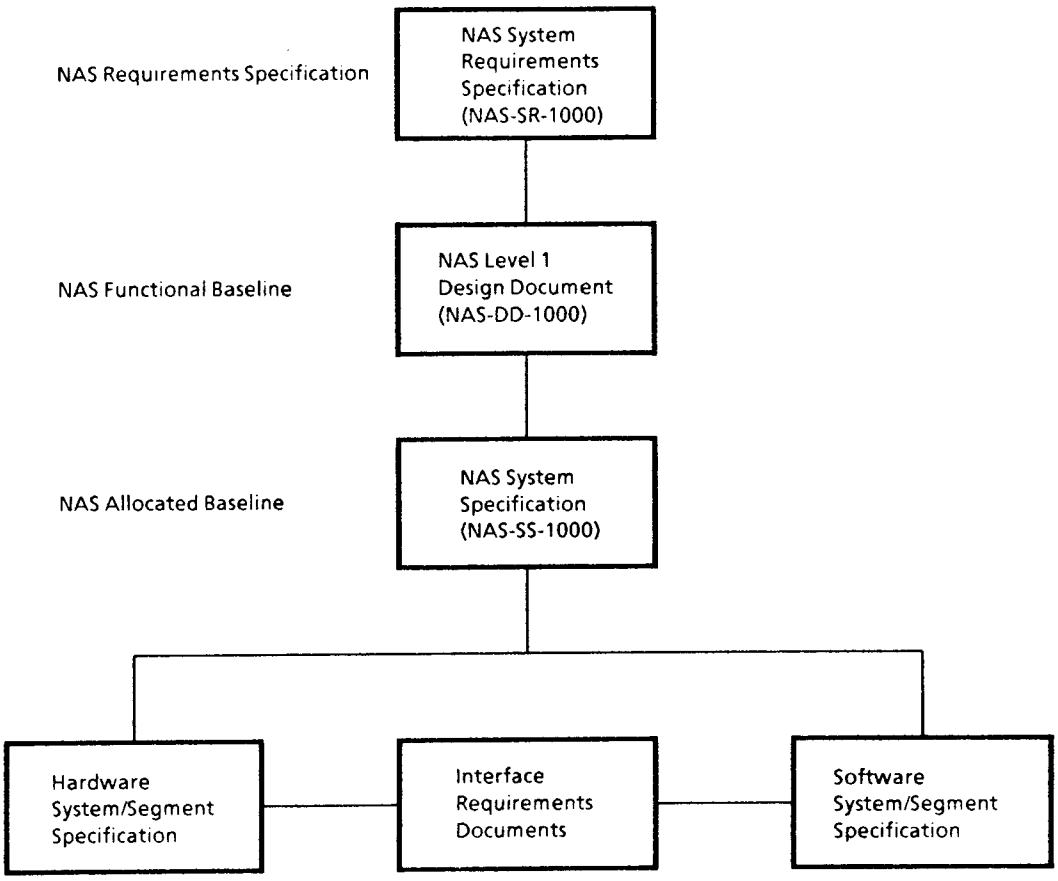


Figure 3 - NAS CM Document Tree

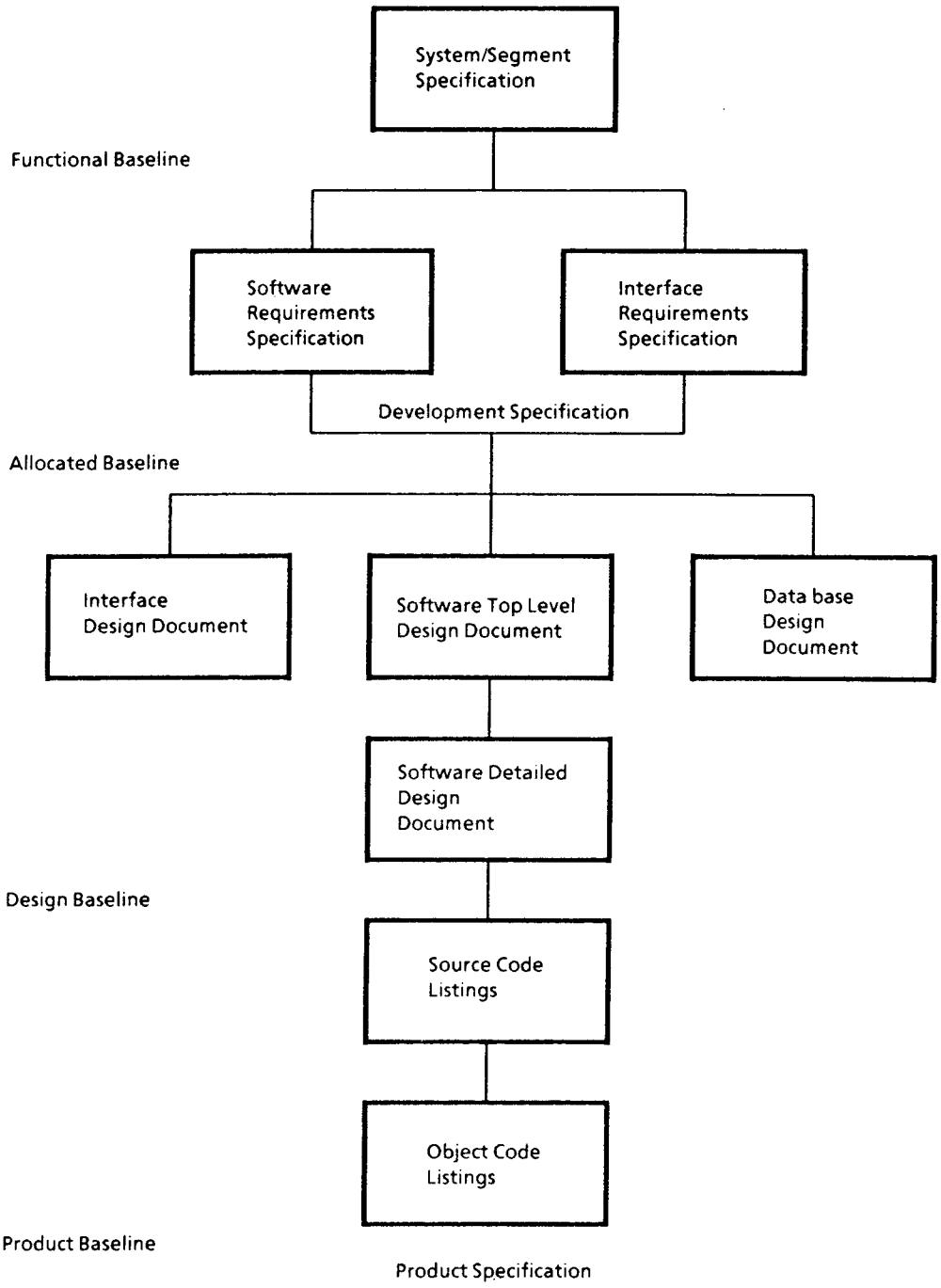


Figure 3 - NAS CM Document Tree (continued)

Hardware Documentation

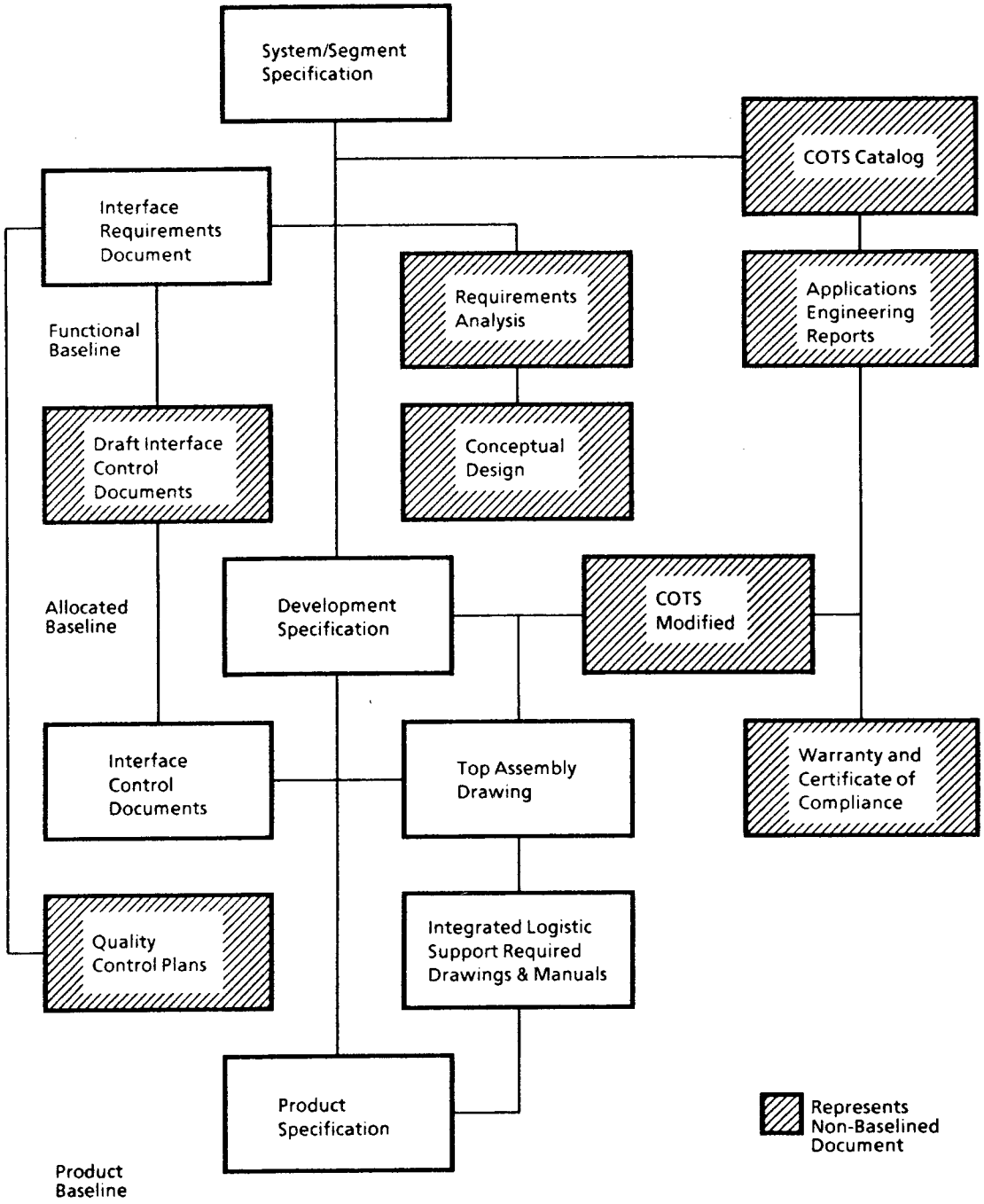


Figure 3 - NAS CM Document Tree (continued)

o Configuration control is the systematic evaluation, coordination, approval or disapproval, and implementation of all approved changes in the configuration of a CI after formal establishment of its configuration identification.

o Configuration status accounting records and reports the information that is needed to manage the configuration effectively. This includes a listing of the approved configuration identification, the status of proposed changes to the configuration, and the implementation status of approved changes.

o Configuration auditing is the formal examination of CI's and associated configuration identification to ensure product integrity prior to establishing a baseline for a CI. Audits can either be formal, conducted at specific points in the CM life-cycle, or in-process, conducted as the government determines necessary.

3.2 CONFIGURATION CONTROL BOARDS (CCB). CCB's are responsible for establishing baselines and managing all changes to those baselines. CCB's provide an important management function since they represent responsibility and accountability over the baseline(s). CCB membership at the NAS and SE level is composed of FAA senior management. Subordinate CCB membership is composed of functional and geographical management. Section 3.4, Baseline Management, discusses baselines further. Figure 4 shows the current CCB structure by life-cycle phase. Figure 5 shows the documentation controlled by each CCB.

3.2.1 The National Airspace System (NAS) CCB is responsible for NAS operational requirements, the NAS Functional (Level I) Design Baseline, and all related system engineering documentation. The NAS CCB is also accountable for the activities of all subordinate boards.

3.2.2 The Systems Engineering (SE) CCB is responsible for NAS Allocated baseline. The SE CCB is also responsible for generic facility end-state drawings and the interface requirements between NAS subsystems.

3.2.3 The Acquisition Division CCB's (APS, ASA, AAP) are responsible for the subsystem functional, allocated, design, and product baselines and administering control for the NAS subsystems under project acquisition. The acquisition division CCB transfers the CM responsibility

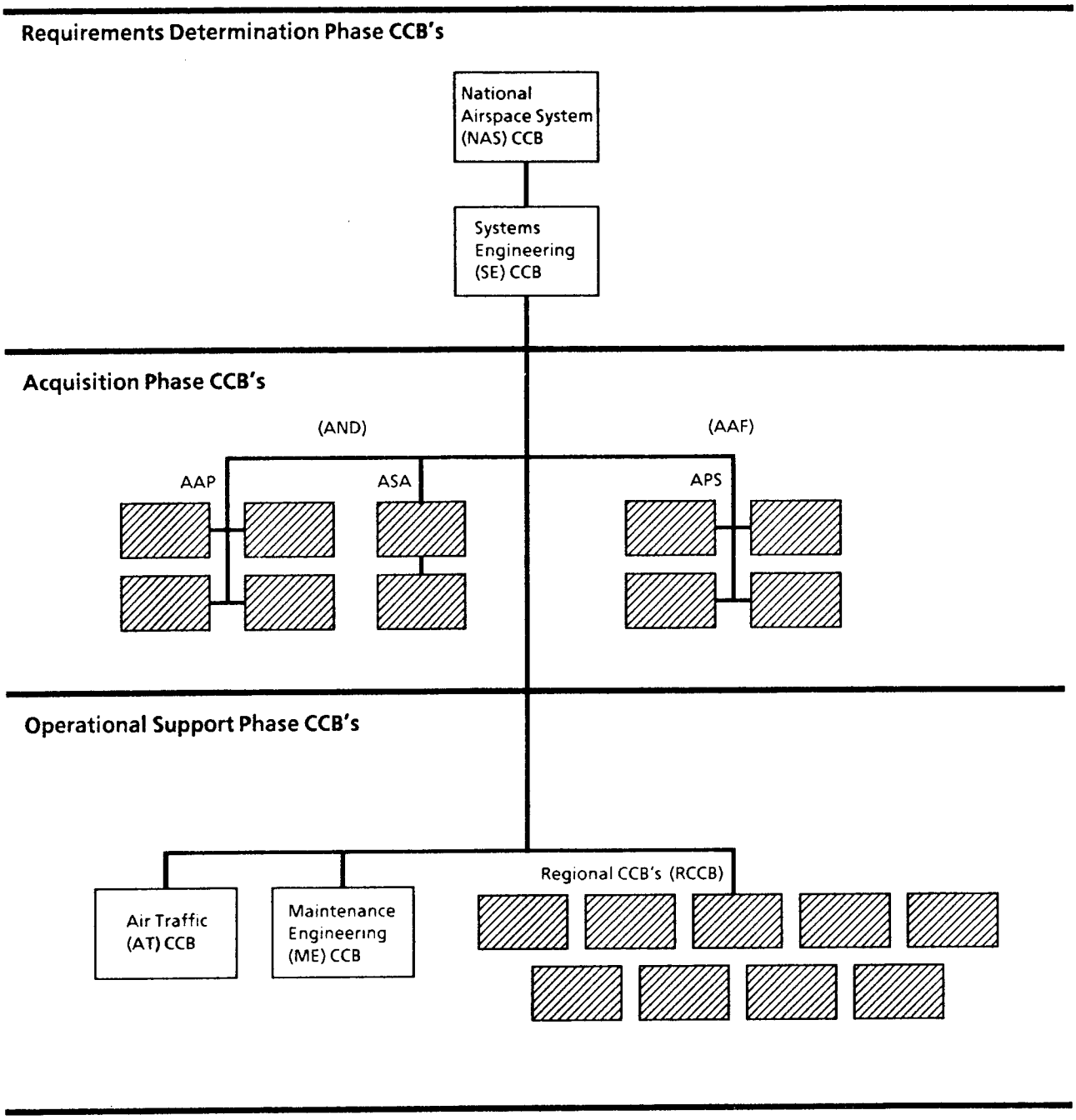


Figure 4 - CCB Structure

Requirements Determination

CCB	Baseline Documentation
NAS CCB (ADM-1)	NAS Systems Requirements Specification (NAS-SR-1000) NAS Level-1 Design Document (NAS-DD-1000)
SE CCB Cochair (AND-1 and AAF-1)	NAS System Specification (NAS-SS-1000) Interface Requirements Documents Interface Control Documents (between Divisions) Generic End-State Drawings

Acquisition Division

CCB	Baseline Documentation
Divisions of: APS AAP ASA	Project Specifications Interface Control Documents (within Division) (APS-100: Generic Site-Specific End-State)

Operational Support

CCB	Baseline Documentation
ME CCB (ASM-100)	Technical Instuction Books EEM/PEM Handbooks Maintenance Handbooks Computer Program Functional Specifications Interface Control Documents
AT CCB (ATR-200)	Computer Program Functional Specifications Interface Control Documents
Regional CCBs	Documentation Describing Regional-Unique Equipment AFSS "As-Built" Drawings ARTCC Drawings

Figure 5 - CCB Controlled Documentation

to the Maintenance Engineering (ME) CCB and/or Air Traffic (AT) CCB, as applicable, as each subsystem completes production and is certified for operational service.

3.2.4 The Maintenance Engineering (ME) CCB is responsible for baselines and administering change control for the NAS hardware and airway facilities maintained software subsystems. The ME CCB's responsibility begins after hand-off by the acquisition division CCB.

3.2.5 The Air Traffic (AT) CCB is responsible for controlling all air traffic control (ATC) software in the operational support phase of its life-cycle. The AT CCB is responsible for establishing operational baselines and controlling changes to those baselines for each configuration item at the computer program functional specification (CPFS) or specification level.

3.2.6 Regional CCB's are responsible for establishing and controlling baselines for regional unique equipment and AFSS as-built equipment layout drawings. The Regional CCB's also control baselines for space management/as-built equipment layout, and critical power panel drawings for ARTCCs which do not affect the end state. There is a Regional CCB for each of the FAA's nine regions.

3.3 FAA CM RESPONSIBILITIES

The FAA CM program strives for a viable working environment which includes on-going communication with all engineering and administrative disciplines including program management, hardware/software engineering, CM, logistics etc. For subsystems in the acquisition phase, these relationships are established prior to, but no later than, contract award, thereby:

- o Eliminating duplicative and/or overlapping activities, thereby reducing total resource requirements for these activities;
- o Providing focus on the bigger problem of ensuring the integrity of the product being developed, including an integrated approach toward monitoring the contractor's effort. The working environment should include many organizations and functions such as those described below.

3.3.1 ASE/AAF - Currently, the Configuration Management Branch, ASE-220, and the Configuration Management and System Design Branch, AAF-4B, share FAA CM responsibility for the NAS. ASE-220 has the lead role in CM policy formulation, program control tool development, and DOCCON. ASE-220 also serves as the NAS and SE CCB Executive Secretariat, assists AND

acquisition programs on CM issues and tasks (audits, policy reviews), and manages the change process for the AAP and ASA CCB's.

AAF-4B has responsibility for CM support to APS Program Managers during NAS Plan project acquisitions and for managing the change process for the ME and AT CCB's. In addition, AAF-4B monitors Regional CCB activity, assists in the formulation of AAF Associate level system engineering positions on proposed NAS designs and changes, and manages the Computer Aided Engineering Graphics (CAEG) Program.

3.3.2 Program Management - The FAA program manager is responsible for all phases of contract performance. A program manager's CM responsibilities include ensuring that CM requirements are invoked on a subsystem within the procurement package, enforced through the acquisition phase, and maintained through CM handoff to the operational support phase. He is responsible for ensuring the scheduling and completion of all reviews and audits. Figure 6 depicts CM as the hub of program management.

3.3.3 Configuration Management Officer - A Configuration Management Officer (CMO) is assigned to most NAS subsystems. The CMO is charged with providing day-to-day project CM support and has multiple project responsibilities. This support includes monitoring contractor CM activities, Contract Data Requirements List (CDRL)/Data Item Description (DID) reviews, baseline management, change processing, CCB Secretariat responsibilities, and subsystem reviews and audits.

3.3.4 Quality Assurance - The Quality Assurance (QA) activity mandates a systematic method of ensuring that material, data, supplies, and services reflect the pre-determined technical requirements of the contract and that the subsystem performs satisfactorily. This encompasses hardware, software

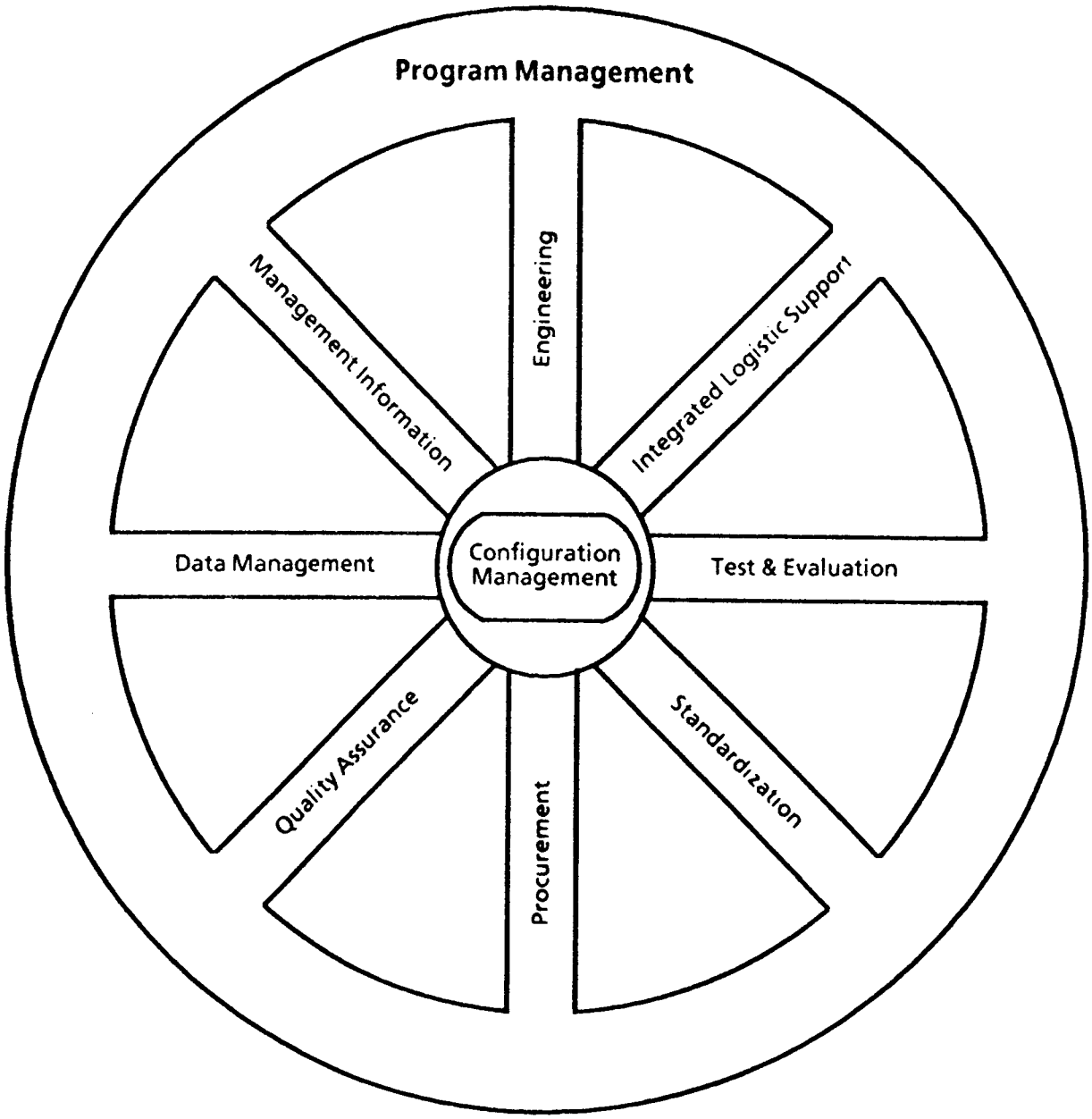


Figure 6 - CM: The Hub of the Program Management Wheel

and firmware. On major acquisitions and most NAS Plan projects, the FAA Quality Reliability Officer is responsible for monitoring quality assurance systems at contractors' facilities.

3.3.5 Systems Engineering - The systems engineering activity is responsible for the design and development of the system/subsystems and the supporting documentation, including the incorporation

of any approved changes in repair manuals, diagnostic manuals, and course material, etc. At FAA, systems engineering is provided by the Systems Engineering and Configuration Management Division, and also through the skills base of the FAA staff.

3.3.6 Independent Verification and Validation - The Independent Verification and Validation (IV&V) activity, generally performed by an independent contractor at FAA, ensures that the performance requirements are correctly interpreted and fulfilled. The IV&V process also verifies product traceability.

3.3.7 Testing and Evaluation - The Testing and Evaluation (T&E) activity assesses whether a project meets its objectives by executing test plans and/or procedures for formal testing. This is accomplished by the contractor and can include functional, integration, and operational testing.

3.3.8 Data Management - The data management activity provides a discipline of controlling the generation, use, and cost of contractor prepared data. Data Management encompasses all documentation which comes with a contractor delivered system. Data items are contractually required via the Contract Data Requirements List (CDRL). CM data includes, but is not limited to, specifications, CM Plans, Audit Plans and Reports, Engineering Change Proposals (ECP's)/Engineering Change Requests (ECR's), deviations/waivers, status accounting reports, and drawings. Special note should be taken of project-unique data requirements including, but not limited to, reprocurement data, source control drawings, rights to data and proprietary data.

It is important that all players and activities involved in FAA configuration management continually communicate with each other and provide feedback on their programs in order to maintain a disciplined product assurance function. The project managers need to work closely with the CMO's and provide them with project technical information, major decision points, and proposed technical

and schedule changes so that the CMO can support those activities as necessary and coordinate their CM efforts with ASE/AAF for overall NAS CM support.

3.4 BASELINE MANAGEMENT

Baseline management spans the entire life-cycle. As a project evolves, additional data is obtained and a baseline is established that can be viewed as a "progressive definition" of the program. Baselines connote the establishment of formal departure points for control of future changes in performance/design. A baseline is a snapshot in time of the configuration identification of configuration items for a given NAS subsystem. The configuration identification at any later time is defined by the baseline plus all subsequently approved changes.

Each NAS baseline provides a particular historical view of the end product as it evolved. Each baseline enables the tracking of requirements, either vertically or horizontally, for traceability through the subsystem's documentation tree. For the acquisition phase, the baseline plus approved change(s) form the contractual basis between the FAA and its contractors. Establishment of a baseline and approval of subsequent changes are the responsibilities of the cognizant CCB.

3.4.1 Configuration Items

At the FAA, each subsystem configuration item and each baseline is uniquely identified in the context of the entire NAS. The program manager ensures that the required configuration item (CI) identification scheme used is dictated to the contractor through the "A" specification and/or procurement package with the guidance for selecting CI's found in FAA-STD-021. The physical as-built CI's (hardware, software and firmware) are not available for inclusion in any baseline until the product baseline is established. The description or specifications defining the CI's are clearly identified. For software items, the as-built software is controlled to the source-code level and the media containing source code is physically included and controlled in the product baseline.

3.4.2 Documentation and Configuration Identification (DOCCON) System

The NAS Documentation Control Center, ASE-221, has been established to serve as the repository and central ordering point for NAS documentation, including baselined documentation data. The NAS Baseline Documentation and Configuration Identification (DOCCON) System is the data base that includes configuration identification data, relational linkage data, documentation data, and status accounting data. This automated tool is used to collect, store, and report data about NAS facilities, hardware, and software. It serves as the FAA's authoritative source of information concerning baselined CI's and associated documentation.

DOCCON is hosted on the FAA's SEI operated computer facility and may be accessed in several ways: dedicated terminal, hard wired personal computer using IBM 3278 terminal emulation, or personal computer via dial-up through the agency Administrative Data Transmission Network (ADTN). Order 1800.8, Chapter 4, provides the procedures for submitting copies of baselined documents and CCB approved changes to those documents to ASE-221. Procedures for using DOCCON can be found in the DOCCON General User's Reference Guide.

3.4.3 Change Control and Status Accounting

Change processing connotes the administrative functions associated with baseline management. Changes to NAS baselines are proposed via change documents which identify the CI to be modified, the reason for the change, the impact of the changes, and a description of the recommended change. The CM/STAT subsystem within DOCCON system allows users to enter data on proposed changes and provides status on case files, NCP's, and Configuration Control Decisions (CCD's).

FAA Form 1800-2 is used to establish or propose a change to a NAS baseline. The proposed change is a case file until it has been approved by a prescreening organization, if prescreening is required and all data has been verified. It is then forwarded to ASE-220/AAF-4B and after successful review, assigned an NCP number through the automated tool. Instructions for completing 1800-2 are on the form. Proposed changes are reviewed by pertinent evaluators and approved/disapproved/deferred at a CCB. Decisions are documented in a CCD and implementation of approved changes are transmitted using Specification Change Notices (SCN), Site Program Bulletins (SPB), Electronic Equipment Modifications (EEM), or Plant Engineering Modifications (PEM). Figure 7 reflects the scope of NAS change processing. See Order 1800.8, Appendix 5 for change processing procedures.

Status Accounting is the operation of a management information system that provides visibility into the current configuration identification of a configuration item, i.e., the baseline, status of proposed, deferred and approved changes to the baseline, and the implementation status of approved changes. Status accounting generates various reports providing information on change proposals in each stage of the review process.

3.4.4 Master Configuration Index

The FAA's Master Configuration Index (MCI) within the DOCCON system is a list of NAS configuration items. The MCI ensures the correct hierarchical representation of the NAS in the DOCCON data base by identifying each NAS CI and its relationship to other NAS CI's. In addition, the MCI links each CI to its associated baselined documentation. From this process, the automated Subsystem Baseline Configuration and Documentation Listing, NAS-MD-001 report is provided. For clarification of a specific subsystem, see NAS-MD-001. It also can provide pertinent status on NAS subsystems (i.e., allocated, design, commissioned/decommissioned).

NAS Life-Cycle Phases		
Requirements Determination	**Acquisition**	**Operational Support**
Baselines: • NAS Requirements - (NAS System Requirement Specification) • NAS Functional - (NAS Level I Design Document) • NAS Allocated - (NAS System Specification)	**Baselines:** • Functional - (System/Segment Specification) • Allocated - (Development Specification) • Design - (Preliminary Product Specification) • Product - (Product Specification and Other Documentation)	**Baselines:** • Operational • Regional
Cognizant CCB's • NAS CCB • SE CCB	**Cognizant CCB's** • Aquisition Division CCB's - APS - ASA - AAP	**Cognizant CCB's** • AT CCB • Regional CCB's • ME CCB
Change Documents: • Tech Employee Suggestion • Case File • NCP • CCD	**Change Documents:** • Tech Employee Suggestion • ECR/ECP • Case File • NCP • CCD	**Change Documents:** • Tech Employee Suggestion • Case File • NCP • CCD
Implementation Document: • SCN • IR	**Implementation Document:** • SCN • IR	**Implementation Documents:** • SCN • PEM • STB • EEM • SPB • IR

Figure 7 - Scope of NAS Change Processing

4.0 CM IN THE LIFE-CYCLE PHASES

4.1 REQUIREMENTS DETERMINATION PHASE - The requirements determination phase at FAA centers around the development of operational requirements and the transition from a series of

functional statements of NAS operational requirements to a NAS design. Each level of design represents more detail. The CM effort concentrates on the technical baselines which are traceable to operational requirements and are supportive of the goals and objectives of the FAA. The top level documentation includes the NAS System Requirements Specification (NAS-SR-1000) which reflects the NAS Requirements Baseline, the NAS Functional (Level I) Design Document (NAS-DD-1000) which reflects the NAS Functional Design Baseline, and the NAS System Specification (NAS-SS-1000) which reflects the NAS Allocated Baseline. In this phase, a subsystem is defined as one or more CI's and is a relatively independent, identifiable functional entity.

The transition from the requirements determination phase to the acquisition phase involves the translation of operational requirements to specific programs and subsequent expansion to specifications and Interface Requirements Documents (IRD) used in acquisition. Resulting project specifications must be presented to and endorsed by the Specification Review Board (SRB) before they are approved by the appropriate acquisition division CCB. All IRD's are approved by the SE CCB.

4.2 ACQUISITION PHASE - To ensure the integrity of CM for the NAS as a whole, FAA contractors on each project have CM programs supplementing the FAA's CM effort during the entire project life cycle. The FAA's goal is a well defined and documented product while at the same time facilitating the FAA's acceptance and transition. The FAA uses the contract statement of work (SOW) as the vehicle for providing a clear, concise description of the contractor's responsibility for implementing a CM program.

SOW's are tailored for each acquisition. Accordingly, CM requirements are individually tailored for the specific acquisition. Project CMO's are responsible for working with the program managers to

ensure that the SOW includes the necessary requirements. Application of such requirements is dependent upon project variables which include:

- o Type of acquisition, i.e. HW/SW, first procurement or reprocurement, developmental or off-the-shelf
- o Acquisition funding level
- o Criteria for subcontractor control
- o Project interfaces

Order 1800.8, NAS CM, communicates the FAA CM policy requirements necessary to implement life-cycle CM on all NAS subsystems. The CMO derives CM policy requirements from 1800.8 and then levies them on the contractor through the invocation of FAA-STD-021, CM (Contractor Requirements), in the SOW. Deliverables produced under the auspices of interagency agreements, through agreements with the Transportation Systems Center, and the FAA Technical Center are subject to CM requirements. See Order 1800.8, Chapter 6 for CM acquisition policy requirements, and FAA-STD-021 for specific CM contractor CM elements.

The FAA specifications for an acquisition always contain a clear, accurate description of the essential requirements for systems, facility, equipment, device, or service. The "A" specification is the first item produced by a project and must be processed through the SRB. The SRB reviews and endorses all new specifications prior to their use in NAS procurements. The board reviews the document prospectus, ensures the document conforms to administrative and format requirements, and endorses the document after final coordination. Following SRB endorsement, documents are presented to the appropriate CCB for baselining. See FAA Order 1800.8, Appendix 4, Specification Review Board, for additional information on the SRB.

After a specification is endorsed by the SRB, an NCP is processed through the appropriate CCB. Upon approval, a CCD is issued, baselining the specification. Any changes to the specification

proposed from this point forward must be processed as an NCP through the acquisition division CCB. If the change is beyond the scope of the acquisition division CCB (e.g. impacts NAS System Specification), it must be transferred to the pertinent CCB authority.

Note that the procurement package refers to the "A" specification, IRD's, the SOW, schedules, CDRL's, DID's, terms, conditions, etc.

4.2.1 Commercial-Off-The-Shelf (COTS)

COTS refers to any product that is sold or traded to the general public in the course of normal business practices. The COTS item can be modified to meet a government-peculiar requirement or addition, or otherwise identified differently from its normal commercial status.

A. COTS Hardware. CM performed on COTS equipment includes inventorying supplied manuals, tracking serial numbers and equipment location matrices, and management of installation space. COTS technical manuals are key instruments in any COTS procurement. The manuals must provide established CI's, serial numbers, a hierarchy, and maintenance information. FAA unique changes to commercially available hardware are identified and controlled in accordance with FAA-STD-021. The FAA ensures that the manuals are procured and that the contractor has included all the information necessary to identify the specific piece of equipment under procurement. The level of maintenance support must be identified in the SOW; for example, full support down to piece part. Contractor maintenance ability of the COTS must be demonstrated during the acquisition as well as depot supportability and maintainability.

B. COTS Software. All commercially available software is identified and established as separate software CI's. FAA unique changes to commercially available software are identified and controlled in accordance with FAA-STD-021. Any additional contractor changes to commercial

software packages and associated documentation are proposed to the Government and must be approved through the CCB process prior to implementation.

4.2.2 Acquisition Baselines - The FAA uses four acquisition phase baselines to manage a subsystem's development process:

- **Functional Baseline** - The functional baseline is derived from the NAS allocated design baseline and defines all essential system functional characteristics, necessary interface characteristics, specific designation of the functional characteristics of key CI's and all tests, demonstrations, or analyses required to demonstrate the achievement of each specified characteristic.

- **Allocated Baseline** - The allocated baseline documents the specific functions to be performed by each subsystem CI. The baseline includes all essential CI characteristics including delineation of interfaces; physical characteristics necessary to assure compatibility with associated systems, CI's, and inventory items; and all tests required to demonstrate achievement of each specified requirement.

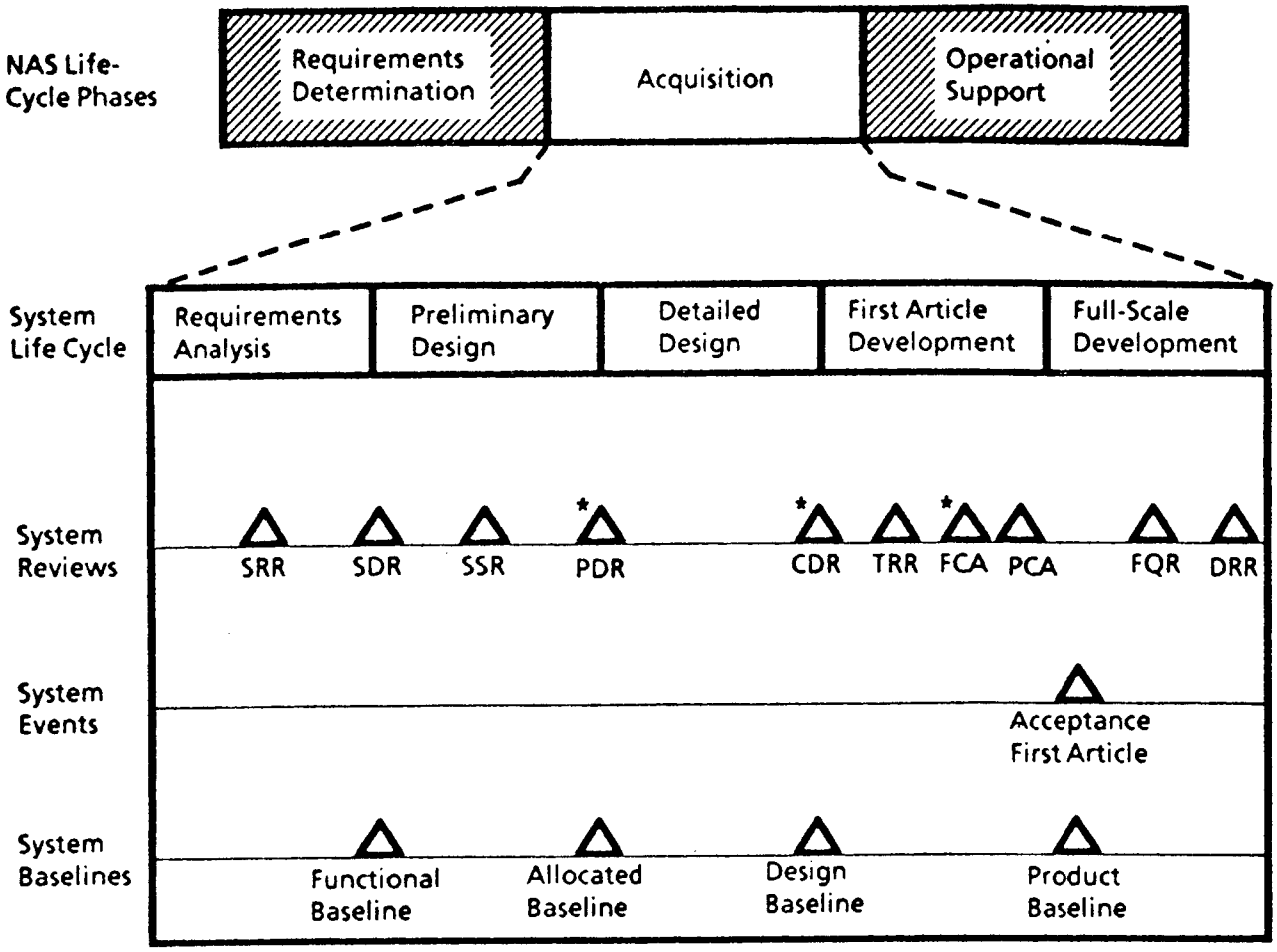
- **Design Baseline** - The design baseline is usually applied to software development programs although hardware can be included. The baseline permits control of NAS software and accompanying test plans and procedures, training, and manuals.

- **Product Baseline** - The product baseline consists of the approved technical documentation defining the configuration of a CI during production, operation, maintenance, and logistics support and the actual equipment and software.

For further information on acquisition baselines refer to Order 1800.8, Chapter 6.

4.2.3 Acquisition Phase Reviews/Events

The CM process supports a series of reviews and events in order to maintain traceability of the development of a system. A key review/event is also associated with the establishment of each baseline. Figure 8 illustrates the acquisition phase review, audit, and event milestones and any associated baseline. Some reviews can be conducted incrementally as noted. Although these reviews are program management responsibilities, CM is the driver. Contractor responsibilities and involvement in reviews/events are performed in accordance to their FAA approved CM Plan. Each review is briefly described below.



SRR - System Requirements Review
SDR - System Design Review
SSR - Software Specification Review
PDR - Preliminary Design Review
CDR - Critical Design Review
TRR - Test Readiness Review
FCA - Functional Configuration Audit
PCA - Physical Configuration Audit
FQR - Formal Qualification Review
DRR - Deployment Readiness Review

* Can Be Incremental Reviews

Figure 8 - Acquisition Phase and Key CM Events

A. System Requirements Review (SRR) - The SRR provides a means to review the FAA's operational and functional requirements. The contractor's total system engineering management activity and its output is reviewed for responsiveness to the contract.

B. System Design Review (SDR) - The SDR evaluates the total system requirements including a summary review of system engineering management activities including CM and an overall review of the operational/support requirements. Successful completion and government approval of the SDR is required prior to establishment of the functional baseline, which generally consists of the functional specification and the interface requirements document describing what the system is to accomplish. At the successful completion of the review, the program office forwards a letter to the contractor stating approval of the review and establishment of the functional baseline.

C. Software Specification Review (SSR) - The SSR is the review of a Computer Software Configuration Item's (CSCI) requirements as specified in the Software Requirements Specification and the Interface Requirements Specification. An SSR can be held for a group of CSCI's treating each item individually if it is beneficial to the FAA. For software intensive programs the allocated baseline can be established at the SSR.

D. Preliminary Design Review (PDR) - PDR's are held (sometimes incrementally) to review the basic design approach for a configuration item or group of items and supporting documentation submitted by the contractor. The contractor conducts the PDR's to demonstrate that all the functions of the subsystem specification have been completely and accurately allocated to the CI specifications. The specific hardware configuration items (HWCI) or computer software configuration items (CSCI) to be covered at each incremental review are identified beforehand.

The initial allocated baseline is set upon the successful conclusion of the initial PDR. The documents specify what functions will be performed by the hardware and software components. The baseline is expanded incrementally (i.e., by the addition of detail design specifications as they are approved) and becomes subject to FAA configuration control with the conclusion of each PDR.

Each PDR reviews development specifications for one or more CI's. Changes to individually approved development specifications are made through the engineering change process. At the successful completion of the last review, the program office forwards a letter to the contractor stating approval of the PDR and establishment of the final allocated baseline. When agreed upon by the contractor and FAA, the allocated baseline can be established as late as Critical Design Review.

E. Critical Design Review (CDR) - CDR's are held (sometimes incrementally) to review and verify specific system designs before detailed coding of software or fabrication of hardware begins. The contractor presents a draft design specification(s) that is reviewed to ensure that the functions allocated by the Development Specification are properly addressed at the "build to" level. The contractor's Interface Control Documents are reviewed for functional and physical interfaces. At the successful completion of the last review, the program office forwards a letter to the contractor stating approval of the CDR, establishment of the design baseline, and authorization to proceed with development and coding. The design baseline provides approved and controlled engineering drawings and form/fit specifications for hardware and detailed design material for software.

F. Test Readiness Review (TRR) - The TRR is conducted in order to assess the contractor's readiness to begin formal testing of a specified configuration item. A technical understanding is reached on preliminary, informal test results, and the validity and accuracy of supporting user manuals.

G. Configuration Audits

An audit is the examination of each configuration item and its configuration identification to verify and document that its development has been accurate and complete, and that its functional and physical requirements have been met. The program manager has the responsibility for ensuring that

the procurement package specifies contractually required audits. The primary thrust of configuration audits is to provide an objective assessment of the integrity of the configuration with other product assurance disciplines including QA, T&E, and IV&V, and to establish the product baseline. For FAA configuration audit policy, see Order 1800.8, Chapter 6. Audits can be either in-process or formal Functional Configuration Audits (FCA) and Physical Configuration Audits (PCA).

(1) In-Process Audits

In-process audits can be conducted anytime during the CM life-cycle phase as the government deems necessary. Any part of the contract requirements can be reviewed for status and compliance. The in-process review is many times used to test a specific procedure depicted in a contractor's CM plan. The review team breaks the CM requirements down to testable units and determines contractor compliance at any time during the subsystem life-cycle.

(2) Functional Configuration Audit (FCA)

The FCA is conducted to determine whether or not the actual performance of each CI complies with its controlling specifications. Specifically, an FCA must verify that the functional, allocated, design (if applicable) baselines and the proposed product baseline are consistent, and that functional requirements are traceable, as shown through the documentation and test results.

(3) Physical Configuration Audit (PCA)

The PCA is a formal examination of CI's to ensure that the technical documentation accurately describes each CI. It verifies "as-built" configuration conformity with the product specifications and document traceability. Successful completion of the PCA is a prerequisite to accepting the final product and to establishing the product baseline.

The FAA carries the lead role and bears the ultimate responsibility for performance and certification of the audit. Configuration audits are conducted for the FAA by the contractor if the audit is contractually specified, or by the FAA if the audit is not within the contractor's requirements. The extent to which a contractor is responsible for or participates in configuration audit efforts depends on the contractual requirements that have been imposed by the FAA in the SOW. For guidance and information on formal configuration audits including roles/responsibilities, resources, and checklists, refer to the "Guidance and Implementation Planning for the Conduct of Formal Configuration Audits."

H. Formal Qualification Review (FQR) - The purpose of the FQR is to verify that the actual performance of the total system (as determined by test) complies with specifications and requirements. Government certification is determined by the success of the review. When feasible, the FQR should be combined with the FCA at the end of configuration item/subsystem testing, prior to the PCA.

I. Deployment Readiness Review (DRR) - The DRR is an FAA event mandated by FAA policy. It is an assessment conducted to assure that the subsystem is ready for the field, the field is ready to accept the subsystem, and the FAA is prepared to incorporate the subsystem into the NAS for operation. DRR activities should be scheduled approximately 180 days prior to first shipment. All projects shall be formally reviewed 150 days prior to scheduled deployment. The results of the review are coordinated with the FAA Program Manager to support a formal FAA Executive Committee (EXCOM) review 60 days prior to deployment. CM, in addition to the various engineering and implementation organizations, provides input to the DRR assessment. CM provides answers to specific CM questions in the DRR checklist. For further information on the DRR, refer to Draft FAA Order 1800.XX, NAS Program Deployment Readiness Review Process.

4.2.4 Project Transition and Handoff

Project transition and handoff are accomplished when a subsystem moves from the acquisition phase to the operational phase. CM supports the transition to ensure that CM responsibility and requirements are handed off and maintained. There are two transition and handoff events. The first is from the contractor to the FAA. CM responsibility and data is transferred by way of the product baseline NCP.

The second transition is from the FAA acquisition activity to the operational support activity. Plans for handing-off to the operational support activity are documented in a memorandum of understanding or project implementation plan which is prepared as soon after contract award as possible. The information provided will include key integration and transition events, the identification of configuration control, and the identification of CI's and their status. Overall, the transition process facilitates agreements and understandings between FAA acquisition and maintenance organizations for the integration and transition of each NAS Plan project.

4.3 OPERATIONAL SUPPORT PHASE. CM in the operational support phase covers fielded equipment, software, and firmware. The current NAS operational baseline is included in NAS-MD-001. For equipment, the operational baseline is listed and controlled by serialized part number, by location and modification level. For software, the operational baseline can be controlled to the computer program member level (source code version level). For COTS, operational support CM activities include update/maintenance of technical manuals and tracking of revision levels.

Changes affecting operational baselines are processed through the AT, ME or Regional CCB's. Engineering Change Requests (ECR's), Engineering Change Proposals (ECP's), and Technical Employee Suggestions (TES) are vehicles for identifying change in this phase. Procedures for

operational changes are included in FAA Order 1800.8, Chapter 7, Configuration Management for NAS Operational Support. In addition, the Interface Control Board (ICB), although not a formal CCB, manages change to automated support systems. This includes commercial hardware, software, and firmware.

Overall, CM responsibilities in the operational support phase ensure the integrity of the operational baseline for all NAS facilities, equipment, and software, including all new projects which complete the acquisition life-cycle phase.

APPENDIX A

REFERENCE DOCUMENTATION

The revisions issue in effect of the documents listed are applicable. For additional documents that may be used in coordination with a CM matter, see Order 1800.8, Appendix 3, Applicable Documents.

FAA Orders

Order 1800.8	National Airspace System Configuration Management
Order 1800.57	National Airspace System Configuration Control Board
Order 6030.29	Assignment & Dissemination of FAA Equipment Type Designation Number for Air Traffic Control and Navigation Systems

FAA Standards

FAA-STD-002	Facilities Engineering Drawing Preparation
FAA-STD-005	Preparation of Specification Documents
FAA-STD-013	Quality Control Program Requirements
FAA-STD-016	Quality Control System Requirements
FAA-STD-018	Computer Software Quality Program Requirements
FAA-STD-021	Configuration Management (Contractor Requirements)
FAA-STD-025	Preparation of Interface Documentation
FAA-STD-026	National Airspace System Software Development

FAA Documents

FAA-G-2100	Electronic Equipment, General Requirements
NAS-MD-001	NAS Subsystem Baseline Configuration and Documentation Listing

Military Documents

MIL-STD-480	Configuration Control-Engineering Changes, Deviations, and Waivers
MIL-STD-482	Configuration Status Accounting
MIL-STD-1521	Technical Reviews and Audits for Systems, Equipment, and Computer Software
DOD-D-1000	Drawings, Engineering and Associated Lists
DOD-STD-100	Engineering Drawing Practices
DOD-STD-2167	Defense System Software Development

NAS CM Documents

CCB Charters and Operating Procedures

Configuration Management Procurement Guidance

Guidance and Implementation Planning for the Conduct of Formal Configuration Audits

APPENDIX B

SELECTED DOCUMENT DESCRIPTIONS

1. FAA Order 1800.8. This document is the highest level CM document in the FAA and establishes CM policy for all NAS projects. It prescribes policies, delegates authority and assigns responsibility to ensure agency compliance to CM requirements. The order further defines requirements for establishing and sustaining a NAS life-cycle configuration management program.

2. FAA-STD-021. This standard establishes the general requirements and implementing practices for a contractor's configuration management program. The CM requirements contained in FAA-STD-021 are invoked through the contractors Statement of Work (SOW) and tailored to the specific NAS project.

3. NAS-MD-001. This document contains guidance for proposing changes to configuration items and the inventory list of CM controlled items that have been baselined within the NAS, and associated documentation. The configuration item may not be modified or amended without submission of an NCP and issuance of a CCD. The CI and documentation listing may also be accessed via DOCCON.

4. MIL-STD-1521. This standard defines the contractor's requirements and responsibilities in conducting technical reviews and audits. It is invoked through the SOW and tailored to the specific NAS project.

5. FAA-STD-026. This document, based on DOD-STD-2167, contains requirements for a uniform software development process which is applicable throughout the system life-cycle. It includes the generation of different types and levels of software and documentation, the application of development tools, approaches and methods, and project planning and control. The standard should

be selectively applied and tailored through the SOW to fit the unique characteristic of each software acquisition.

6. **Configuration Management Procurement Guidance**. This document presents guidelines for ensuring that clear, concise CM requirements are included in the contractor's SOW. Generic CM Contract Data Requirements List (CDRL's) and Data Item Descriptions (DID's) are attached.

7. **CCB Charters and Operating Procedures**. FAA Order 1800.57 defines the authority, responsibility and membership of the NAS Configuration Control Board (CCB). FAA Order 1800.57 empowers the NAS CCB to charter all other CCB's, including each of the acquisition division CCB's. All CCB's develop and document their own CCB operating procedures. The procedures define the specific CCB method of operation to include preparation for and conduct of CCB meetings. Each respective CCB chairperson approves the CCB's procedures.

8. **Guidance and Implementation Planning for the Conduct of Formal Configuration Audits**. This document is designed to assist the FAA in planning, conducting and evaluating functional and physical Configuration Audits. The checklists included are to be tailored to each project and selectively applied as appropriate.

APPENDIX C

ACRONYMS AND ABBREVIATIONS

The following list represents some CM acronyms and abbreviations used within the FAA.

ADTN	Administrative Data Transmission Network
AT	Air Traffic
CCB	Configuration Control Board
CCD	Configuration Control Decision
CDR	Critical Design Review
CDRL	Contract Data Requirements List
CI	Configuration Item
CM	Configuration Management
CMO	Configuration Management Officer
CMP	Configuration Management Plan
CM/STAT	Configuration Management/Status Accounting Subsystem
COTS	Commercial-Off-The-Shelf
CPFS	Computer Program Functional Specification
CSCI	Computer Software Configuration Item
DCC	Document Control Center
DID	Data Item Description
DOCCON	Documentation and Configuration Identification System
DOD	Department of Defense
DRR	Deployment Readiness Review
ECP	Engineering Change Proposal
ECR	Engineering Change Request
EEM	Electronic Equipment Modification

EXCOM	Executive Committee
FAA	Federal Aviation Administration
FCA	Functional Configuration Audit
FQR	Formal Qualification Review
HWCI	Hardware Configuration Item
ICD	Interface Control Document
IR	Interface Revision
IRD	Interface Requirements Document
IV&V	Independent Verification and Validation
LIDD	Level I Design Document
MCI	Master Configuration Index
ME	Maintenance Engineering, Must Evaluator
MOU	Memorandum of Understanding
NAS	National Airspace System
NASA	National Air and Space Administration
NASSRS	NAS System Requirements Specification
NCP	NAS Change Proposal
PCA	Physical Configuration Audit
PDR	Preliminary Design Review
PEM	Plant Engineering Modification
PIP	Program Implementation Plan
QA	Quality Assurance
SCN	Specification Change Notice
SDR	System Design Review
SE	Systems Engineering
SOW	Statement of Work

SPB	Site Program Bulletin
SRB	Specification Review Board
SRR	System Requirements Review
SSR	Software Specification Review
STB	Site Technical Bulletin
T&E	Test and Evaluation
TRR	Test Readiness Review

Federal Aviation Administration
Configuration Management Manual

Your comments and suggestions will help us in our continuous effort to improve the quality and usefulness of our manual.

What is your general reaction to this manual (format, accuracy, completeness, organization, etc.)?

_____

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What features are most useful? _____

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Does the manual satisfy your needs? _____

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What errors have you found? _____

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